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ABSTRACT

As schools acquire and use computers for educational purposes, two major questions arise: (1) whether students from different strata of society will obtain equal access to computers, and (2) whether students from different strata of society will be taught similar or different uses of the computer. To explore the relationship between the characteristics of schools, the students they educate, and students' access to computers, observations of computer use were conducted in 21 classrooms in five Southern California School Districts. A very strong relationship was found between the type of students who are being educated using computers and the type of instruction that is being presented to them. Boys and girls had differential access to computers, especially in secondary schools. (In elementary schools with central lab facilities, girls and boys had equal access.) Ethnic minority and lower class students received a different kind of instruction than did their white middle class and ethnic majority contemporaries. White middle class students received instruction which encouraged learned initiative (programming and problem solving). Lower class and ethnic minority students received instruction which maintained control of learning in the computer (computer aided drill and practice). Basic computer literacy courses emphasize programming, but increasingly employers are seeking individuals with skills in applications such as word processing, spreadsheet analysis, and data systems management. Typically, only students who progress to advanced courses learn these skills. Ethnic minorities are often excluded. Serious consideration of these policies is necessary to avoid a system of stratification based on access to information technology. (25 references) (GL)

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Report #9

Computer Literacy and Social Stratification

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Report #9

Computer Literacy and Social Stratification

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Computers are being promoted as the revolutionary educational tool of the 1980s. Almost daily, we are are being informed of the the dangers of a society which is not computer literate, and almost with blind faith, schools are taking on the responsibility of supplying computer education. As history has shown us, however, innovations in school systems have had unforseen consequences for those systems (Sarason, 1982); previous technological innovations--such as the radio, educational television, tape-recorders--have had a remarkably short life in schools (Tyack, 1985). As schools acquire and use computers for educational purposes several major questions concern us:

--will students from different strata of society obtain equal access to computers?

--will students from different strata of society be taught similar or different uses of computers?

In order to get some sense of the relationship between the characteristics of schools, the students they educate and students' access to computers, we observed computers being used in 21 classrooms in five Southern California school districts (CUSG, 1983; Boruta and Mehan, 1985). We found a very strong relationship between the type of students who are being educated using computers and the type of instruction that is being presented to them (cf. CSOS, 1983).

Current Uses of Computers

School districts developed entirely new courses of study in computer literacy. Computers were used primarily for basic skills instruction and computer programming (cf. CSOS, 1983). When computers were used for basic skills instruction, students were given computer aided drill and practice (CAI) on material which supported instruction they received in their classrooms. When students were taught computer programming, most were introduced to the BASIC computer language. Computers were used for writing (Rubin and Bruce, 1983; Levin, 1983; Riel, 1985), music and art far less often than they were used for CAI and computer literacy.

Computer literacy courses were taught outside of the framework provided by traditional curricular subjects. In many of these courses machine operations were taught separately from the uses that the computer can have for academic and occupational purposes. Students were first taught how to locate machine parts, insert disks, boot programs, manipulate files, operate the keyboard, printer and monitor. Once they have learned machine operations they were introduced to computer programming. Only students who progressd to advanced courses learned about computer applications such as text editing, spread sheet analysis or data systems management. In short, the educational approach adopted in computer literacy curricula is atomistic. The assembly of the parts of the task (machine operations) into the whole task (machine applications) comes after students master the components of the subtask.

Stratified Access to Computers

The stated policy of many schools that have computers is to give all students equal access to computers for instructional purposes. Disparities between stated policy and observed practice point to the potentially stratifying effects of computer use.

Access to fundamental and advanced computer uses were differentially distributed along gender and ethnic lines.

Boys and girls had differential access to computers, especially in secondary schools (cf. Sheingold et al, 1983). In elementary schools which had central lab facilities, girls and boys had equal access. Observations of voluntary times on computers (for example, at lunch and at recess), however, revealed more boys than girls using computers in their spare time. The stratification of boys and girls on computers coincides with the timing of curricular division of boys and girls into math and science subjects.

Ethnic minority and lower class students received a different kind of instruction than did their white middle class and ethnic majority contemporaries. White middle class students (especially those in classes for the "gifted and talented"), received instruction which encouraged learned initiative (programming and problem solving). Lower class and ethnic minority students (especially those in federally funded supplemental education programs), received instruction which maintained control of learning in the machine (computer aided drill and practice).

This differential access was even pronounced in the "Chipotle School," established as a "computer magnet school" in order to attract white families to an inner city ethnic neighborhood. The magnet functioned almost as two separate schools, with ethnic neighborhood students in one school and imported white students in the other. Ethnic minority students from the local neighborhood, who were not part of the magnet program, had their only contact with computers in Math and English Skills labs, which used the computer to reinforce basic skills by drill and practice techniques. Most of the white students in the magnet had access to the computers for programming and problem solving activities.

Problems with Current Uses of Microcomputers

Using computers primarily for drill and practice or computer literacy and limiting low income and ethnic minority children's access to advanced uses of computers represents educational policy that should be examined critically for several reasons: (1) the full power and range of computers is not being exploited when they are used for drill and practice in basic skills and (2) a computer literacy curriculum emphasizing programming in a general purpose language like BASIC does not prepare students for the world of work.

CAI Does Not Exploit the Computer's Capabilities

The fast pace and packaged format of CAI drill and practice software does not provide students time to deliberate, reconsider or challenge prespecified answers. These programs concentrate on curricular subjects in which knowledge can be said to have correct or incorrect answers which may

lead to an already existing emphasis on learning facts. Facts are more easily translated into computer programs than are conceptual ideas. The student is then called upon to provide the right answer to someone else's question without an equivalent emphasis being placed on asking their own questions, applying their understanding to new situations or working with peers to explore their learning skills (Becker, 1985).

While there is some evidence to suggest that CAI programs can deliver basic skills instruction better than conventional techniques (Kulik et al, 1983), critics of such studies (Tucker, 1983) point to methodological problems and omissions of cost comparisons. Most of this research has been done under conditions which have allowed many computers to be used at one time, not under the conditions which are more typical of schools with only a few recently purchased computers. Furthermore, when the novelty of working with computers for the first time wears off, CAI workbook pages do not have the motivating effect required to sustain students' interest (Malone, 1981). In addition, the current readability and graphic quality of electronic worksheets is poorer than printed workbooks, which makes their use as an alternative medium of communication between teacher and student questionable.

General Purpose Programming Does Not Meet The Needs of the Workplace

Computer programming is emphasized in computer literacy curricula because programming enables students to gain control of the machine (Papert, 1980) and it is supposed to strengthen students' higher level reasoning

skills. While there is no reason to argue against the first premise, there is little evidence to support the second (Pea and Kurland, 1984; Mehan et al, 1985). Even if there were considerable evidence to suggest that learning to program enhances higher order thinking, it may be short sighted to teach all students to program in BASIC.

BASIC is a general purpose programming language. While its linear structure makes it relatively easy to learn initial commands and statements, this same structure makes it difficult for beginning students to create any but the most rudimentary programs. BASIC is also limited in that it does not easily allow for hierarchically arranged programming procedures as do more modern languages, such as PASCAL or LOGO. Whether working in BASIC, PASCAL or LOGO, however, students receive only a limited sense of the computer's power. With special purpose languages such as Interactive Texts or spread sheets, students develop a richer sense of how to structure problems effectively and to approach problems in a disciplined way, (i.e., two of the general or "metacognitive" skills that some cognitive scientists (Brown and Campione, 1984) believe can be widely applied to solving problems).

While it is not entirely clear what school children need to learn <u>now</u> in order to be competent and useful in the 21st century, most computer scientists believe that in a few years very few people will be actually writing computer programs with general purpose languages. Increasingly, microcomputers are being used in business and industry for word processing, spread-sheet analysis, and data systems management--applications which do not require knowledge of general purpose computer languages. These business applications are being implemented, not by highly skilled programmers but by

employees learning to create electronic forms and spread sheets provided by special purpose user friendly programs (e.g., Visicalc, Apple Works). Eventually, computers will write programs in response to spoken or typed requests made in ordinary English (Kay, 1983), further reducing the need to produce a multitude of general language programmers.

The shift in computer uses from those dependent upon general purpose programming languages to those using special purpose programs suggests that even though our society may rely heavily on the computer, we will not need vast numbers of programmers. Even though there is a shortage of general purpose programmers now, we are likely to need far fewer in the future.

The available evidence suggests that most jobs will not be found in high technology industries, nor will high technology require a vast upgrading of the American labor force (Levin and Rumberger, 1984). On the contrary, the proliferation of high technology industries is far more likely to reduce the skill requirements in the U.S. economy than to upgrade them.

Levin and Rumberger (1984) cite Labor Department projections that say jobs for computer programmers will grow between 74% and 148% during the 1980s, while overall job growth will be only 22%. These percentages are misleading, however. The total number of new jobs for computer programmers is expected to be 150,000. Some 1.3 million new jobs are projected for janitors, nurses aides and orderlies. That is nine unskilled jobs in these categories for every computer programmer. New jobs for data processing machine mechanics will increase 148%, the fastest growing job category. But

that large gain translates into an increase of fewer than 100,000 new jobs, while 800,000 new jobs are projected for fast-food workers and kitchen helpers alone.

There will neither be a proliferation of systems analyst jobs, nor will the high-tech jobs create demands for increasingly sophisticated work skills. On the contrary, the new technologies further simplify routine tasks and reduce the opportunities for worker individuality and judgment. In such diverse areas as office administration, data processing, drafting, and wholesale and retail trade, microcomputers are making it possible to employ persons with lower skills to perform what had previously been highly sophisticated jobs.

The ways in which computers are used in the world of work have implications for the widespread teaching of programming presently pervading our curricula. Strictly on intellectual and academic grounds, it may be important for students to gain some exposure to programming. Indeed, programming may enable students to gain a sense of how the computer operates and develop some skills in structuring problems. But, devoting years of a student's time to programming instruction can not be justified on the grounds that we are providing skills that students will require professionally (Tucker, 1983). We may need tens of thousands of general purpose programmers, but not the millions we will be producing with the current emphasis on programming in schools (Levin and Rumberger, 1984).

Computer Literacy and Stratified Access to Technology

Differential access along gender, ethnic and socioeconomic lines is one of the ways in which the microcomputer can become a medium which contributes further to the stratification that already exists in our society.

School districts are developing entire computer literacy curricula for teaching students about the operation of the computer. In many of these courses machine operations are taught separately and distinctly from the uses that the computer can have for academic and occupational purposes. Students are first taught how to locate machine parts, insert disks, boot programs, manipulate files, operate the keyboard, printer and monitor. Once they have learned machine operations they are introduced to computer programming, usually in BASIC or PASCAL. Only students who progress to advanced courses learn about computer applications such as text editing, spread sheet analysis or data systems management.

In short, the educational approach adopted in computer literacy curricula is atomistic and stratified. The assembly of the parts of the task (machine operations) into the whole task (machine applications) comes after students master the components of the subtask. Access to advanced courses is stratified along ethnic, gender and socioeconomic lines.

If computer literacy is decontextualized by having students learn about the computer without leaning what it can do, then we fear that computer literacy requirements can become yet another form of "cultural capital" for students to acquire, rather than being a meaningful educational experience in which usable skills are taught in understandable ways.

Our fear is grounded in two recent strands of research. One discusses the cognitive consequences of educational tracking; the other discusses the use of educational credentials as a mechanism to control access to prestigious occupations.

The Cognitive Consequences of Tracking.

Credential Inflation. As members of disadvantaged or disenfrancised groups seek access to higher rungs on the occupational ladder, more extensive credentials are imposed as requirements for entry. This "credential inflation" has the social consequence of retaining the relative ranking of social groups, even though successive generations of lower-level groups acquire more education and credentials.

The knowledge dispensed in computer literacy curricula can become a new form of "cultural currency," the coin of the realm for gaining access to the more sophisticated jobs in the labor market. If computer literacy credentials will in fact give a differential advantage to those who obtain them, and if students are tracked through computer literacy courses, then we can conclude that these new credentials will benefit different people differentially. Those people who are more likely to obtain lower level computer knowledge and the accompanying lower level computer literacy credentials will be from lower-status backgrounds, while those obtaining advanced knowledge with the accompanying more prestigious credentials will come from higher status backgrounds. And the higher level, more prestigious credentials will lead high status people to better paying jobs while lower

status people will be targeted for lower paying jobs.

Instead of making computer programming the single entry point and pinnacle of computer literacy, we are suggesting that it is important to provide students with "multiple entry points to expertise" (Levin and Souviney, 1983). We have had some success contextualizing computer literacy and making it widely available to students from a wide range of socio-economic backgrounds. We assisted four teachers who taught their elementary school students about computer operations within the context of teaching them about computer uses, including writing and editing (Mehan et al, 1985). Students spent on the average of 25 minutes a week in language arts and 25 minutes a week in mathematics at the computer. This means that they had 15 hours at the computer by the end of the school year. The students in these classrooms learned to write and edit using a microcomputer, and, they learned to operate the machine without a specific and special course designed to teach them about the machine.

If our modest results can be replicated, they have broad implications for teaching computer literacy. This study suggests that it is not necessary to develop a special, separate and independent curriculum called computer literacy. Instead, the teaching of machine operations can be embedded in the teaching of academic tasks, thereby providing students from all socioeconomic backgrounds with "multiple entry points" for using computers as powerful tools for a wide range of applications. For some students, that power will come through the ability to program the computer. But, for others, that power could and should come, we feel, from knowing how to use

the computer, to write and edit text, to create music, graphics and animation, to organize information and to communicate it to others. Furthermore, one avenue of access does not preclude another. Just as the student who begins learning about computers by programming them is not precluded from assembling spread sheets later on, so, too, the student who learns text editing first is not precluded from learning to program later.

Conclusion

If only a few people learn to control computers, (and those are from the upper echelons of society), while most can only react passively to them (and they are from the lower strata), then we will have a system of stratification based on access to information technology (Shiller, 1981) that will make the ones based on economic capital (Marx, 1964) and cultural capital (Bourdieu and Passeron, 1977; Collins, 1980; DiMaggio, 1985) pale by comparison. Although differential access to knowledge about information technology is already appearing, there is still time to address the issue. One way to counter this trend is to insure that the computer literacy curricula of our schools does not artificially track students from different strata of society, but provides all students with equal access to information technology.

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